U. S. NAVAL AMMUNITION DEPOT

CRANE, INDIANA

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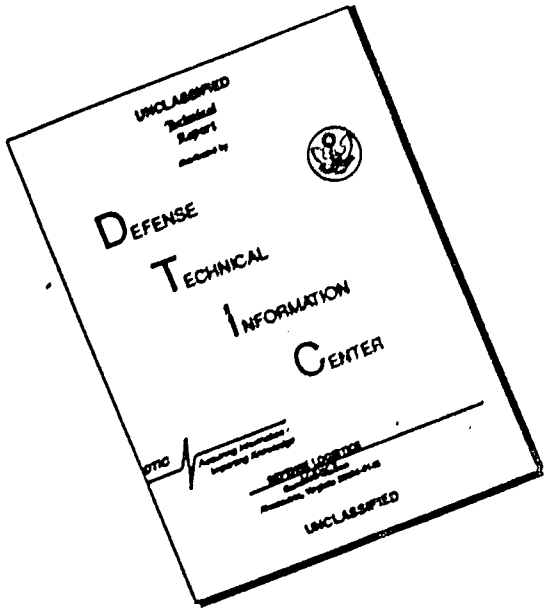

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U. S. NAVAL AMMUNITION DEPOT
Crane, Indiana

RDTR No. 71
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AIR REACTIVE COMPOUNDS:
Listing and Properties

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Released

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ABSTRACT

Properties of air reactive compounds are listed.

INTRODUCTION

The data in PART I regarding air reactive compounds were collected from Handbook of Organometallic Compounds, Herbert C. Kaufman, 1961. The information is reprinted herein through the courtesy of D. Van Nostrand Company, Inc. Abbreviations and notation are as defined in the following pages.

The data in PART II were collected by D. M. Johnson. They are included to provide leads to additional information.

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PART I

ABBREVIATIONS

a - acid
ac.a. - acetic acid
acet. - acetone
alc. - alcohol
alk. - alkali
arom. - aromatic solvents
BM - Bohr Magnetons
C - Centigrade
c - cold
cp - centipoises
cs - centistokes
D - Debye units
d - decomposes
deg - degree
deliq. - deliquescent
eth - ethyl ether
exp - explodes
ext - extrapolated
F - Fahrenheit
h. - hot
hyg. hygroscopic
i. - insoluble
i- - iso
inf. - infusible
infl. - inflammable
Kcal - kilocalories
m- - meta
n - normal
o- - ortho
p- - para
pyr. - pyridine
s. - soluble
sec. - secondary
sl. - slightly
spon. - spontaneously
subl.-sublimes
sym. - symmetrical
tert. - tertiary
uns. - unsymmetrical
v. - very
∞ - miscible, infinite
> - greater than
< - less than

PHYSICAL PROPERTIES

Characteristics - The color and state of aggregation are posted when available.

Solubility - The solubility of a given compound in a solvent is expressed gross terms such as soluble, slightly soluble, insoluble, or decomposes.

Refractive Index - Values posted are indicated by a specific temperature in °C and for a given spectral line.

Specific Gravity - Values are posted at a given temperature in °C, which may be referred to water at the same or another temperature.

Melting Point - Values are given in °C. A "d" before the figure indicates decomposition without melting, a "d" after the figure indicates decomposition upon melting.

Boiling Point - Values are shown in °C with an atmospheric pressure range of 740-770 mm of mercury indicated.

Vapor Pressure - The prime figure indicates the temperature in °C, the superscript, vapor pressure in mm of mercury. Occasionally, the vapor pressure equation is given where available.

Viscosity - Values are posted in terms of centistokes, centipoises, or millipoises, as specified.

Thermodynamic Values - Values are given for a specific temperature (25°C unless otherwise stated). The units are given in each instance.

Flash, Fire, and Autoignition Temperatures - These values are posted in °F.

Surface Tension - Values are expressed in dynes/cm unless otherwise stated.

Dipole Moments - These values are shown in Debye units.

LITHIUM

$LiCH_3$

Name	Methyl lithium
Formula	CH_3Li
Molecular Weight	21.96
Characteristics	solid
Melting Point	infus.
Addenda	spon. infl.
Reference	

Annotated Bibliography on the Use of Organo-Lithium Compounds, Supplements 1-5 (1949-59), Metalloy Corp., Minneapolis

Li_2CH_2

Name	Methylene dilithium
Formula	$LiCH_2Li$
Molecular Weight	27.91
Characteristics	solid - brown
Solubility	d. H_2O, air; i. all
Addenda	spon. infl.

SODIUM

$NaCH_3$

Name	Methyl sodium
Formula	CH_3Na
Molecular Weight	38.00
Characteristics	solid
Solubility	l. org.; d. air, H_2O
Melting Point	d. 200
Addenda	spon. infl.

NaC_2H_5

Name	Ethyl sodium
Formula	C_2H_5Na
Molecular Weight	52.06
Characteristics	crystalline - white
Solubility	d. H_2O, al., eth., air; i. org.; s. diethyl zinc
Melting Point	d.
Addenda	spont. infl.

W. Schlenk, J. Holz - Ber. 50, 262 (1917)

COPPER

$CuCH_3$

Name	Methyl copper
Formula	CH_3Cu
Molecular Weight	78.58
Characteristics	gas
Solubility	s. eth.
Addenda	spont. infl.

BERYLLIUM

BeC_2H_6

Name	Dimethyl beryllium
Formula	$(CH_3)_2Be$
Molecular Weight	39.08
Characteristics	needles - white
Solubility	s.h. ether
Melting Point	200 Subl.
Boiling Point	d. 190
Vapor Pressure	108^{1}, $158.6^{30.5}$
Addenda	spont. inflam.
Heat of Sublimation	22 Kcal/mole

G. E. Coates, F. Glockling - J. Chem. Soc., 1954, 2526-9

G. E. Coates, F. Glockling - J. Chem. Soc., 1954, 22-7

BeC_4H_{10}

Name	Diethyl beryllium
Formula	$(C_2H_5)_2Be$
Molecular Weight	67.13
Characteristics	liquid - colorless
Solubility	s. org.
Melting Point	-13 to -11
Boiling Point	194^{ext}
Vapor Pressure	$93\text{-}95^{4}$ d.
Addenda	spont. inflam.

G. E. Coates, F. Glockling - J. Chem. Soc., 1954, 22-7

MAGNESIUM

$MgCH_2$

Name	Methylene magnesium
Formula	$MgCH_2$
Molecular Weight	38.35
Characteristics	amorphous - rust
Solubility	d. H_2O, air; i. org.
Addenda	spon. infl.

MgC_2H_6

Name	Dimethyl magnesium
Formula	$Mg(CH_3)_2$
Molecular Weight	54.50
Characteristics	solid
Solubility	s. ether
Melting Point	d. 200
Vapor Pressure	$190^{0}.2$
Addenda	spont. inflam.

MgC_8H_{18}

Name	Dibutyl magnesium
Formula	$(C_4H_9)_2Mg$
Molecular Weight	138.72
Characteristics	crystalline
Solubility	s. ether
Melting Point	d. 200
Addenda	spont. inflam.

Kaufman, H.C., Handbook of Organometallic Compounds, D. Van Nostrand Company, Inc., New York, 1961, p. 30

ZINC

ZnC_2H_6

Name	Dimethylzinc
Formula	$(CH_3)_2Zn$
Molecular Weight	95.45
Characteristics	liquid - colorless
Solubility	d. H_2O, alc; s. org
Specific Gravity	(10) 1.386
Melting Point	-42
Boiling Point	46
Vapor Pressure	0^{124}
Addenda	spont. inflam.

R. C. Krug, P. J. C. Tang - JACS, 76, 2262-3 (1954)

Handbook of Chemistry and Physics, Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

ZnC_4H_{10}

Name	Diethylzinc
Formula	$(C_2H_5)_2Zn$
Molecular Weight	123.50
Characteristics	liquid - colorless
Solubility	d. H_2O, alc.; s. org.
Refractive Index	(8/Hα)1.4936
Specific Gravity	(18) 1.182; (20/4) 1.2065; (8/4) 1.245
Melting Point	-28
Boiling Point	118
Vapor Pressure	30^{27}
Addenda	spont. inflam.

R. C. Krug, P. J. C. Tang - JACS, 76, 2262-3 (1954)

Handbook of Chemistry and Physics, Chemic ubber Publishing Co., Cleveland, Ohio (1958)

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ZnC_6H_{14}

Name	Di-n-propyl zinc
Formula	$(C_3H_7)_2Zn$
Molecular Weight	151.55
Characteristics	liquid
Solubility	d. H_2O; s. org.
Refractive Index	(18.6/D) 1.4845; (18.6/Hα) 1.4803
Specific Gravity	(20/4)1.1034
Boiling Point	160
Vapor Pressure	48^{10}
Addenda	spont. infl.

R. C. Krug, P. J. C. Tang - JACS, 76, 2262-3 (1954)

Handbook of Chemistry and Physics, Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

CADMIUM

CdC_2H_6

Name	**Dimethyl cadmium**
Formula	$(CH_3)_2Cd$
Molecular Weight	142.48
Characteristics	liquid - colorless
Solubility	d. H_2O; s. org.
Refractive Index	(18/D)1.5849
Specific Gravity	(17.9)1.9846
Melting Point	-2.5
Boiling Point	105.5
Addenda	musty odor; spont. infl.
Heat of Fusion	(18) 9153 cal/mole
Atomic Refraction	12.61

E. Krause, A. von Grosse - Die Chemie der Metallorganischen Verbindungen, Brontraeger, Berlin (1937)

CERIUM

CeH_3

Name	Trihydro cerine
Formula	CeH_3
Molecular Weight	143.15
Characteristics	powder - black
Solubility	d. air, H_2O
Specific Gravity	5.5 g/cc
Melting Point	1080 d.
Vapor Pressure	$450\text{-}500^{0}.5$
Heat of Formation	42.26 Kcal/mole
Addenda	spont. infl.

D. Hurd - Chemistry of the Hydrides, Wiley, New York (1952)

THORIUM

ThH_3

Name	Thorium hydride
Formula	ThH_3
Molecular Weight	235.07
Characteristics	powder - black
Addenda	spont. infl.

BORON

BC_3H_9

Name	Trimethyl borine
Formula	$B(CH_3)_3$
Molecular Weight	55.92
Characteristics	gas - colorless
Solubility	s. org.; d. air
Specific Gravity	(-100) 0.63; 1.9108 g/l
Melting Point	-153 (-161.5)
Boiling Point	-20
Vapor Pressure	-50^{80}; -80^{31}
Heat of Vaporization	5.7 Kcal/mole
Heat of Combustion	23,000 Btu/lb
Addenda	spont. infl.

Callery Chemical Co. PB - 124518 (1951)

G. Urry, J. Kerrigan, T.D. Parsons, H.I. Schlesinger - JACS, 76, 5299 (1954)

$BC_6H_{14}Cl$

Name	Dipropyl chloroborine
Formula	$(C_3H_7)_2BCl$
Molecular Weight	132.45
Characteristics	liquid - colorless
Solubility	s. org., d. O_2
Specific Gravity	(20) 0.848
Melting Point	<125
Boiling Point	127
Addenda	spont. infl.

L. H. Long, D. Dollimore - J. Chem. Soc., 1953, 3902-10

BC_6H_{15}

Name	Triethyl borine
Formula	$(C_2H_5)_3B$
Molecular Weight	98.10
Characteristics	liquid - colorless
Solubility	s. org., d. air
Refractive Index	(20/D)1.4485
Specific Gravity	(20) 0.696
Melting Point	-93
Boiling Point	95
Vapor Pressure	$0^{12.5}$
Heat of Combustion	21,900 Btu/lb
Addenda	spont. infl.

$BC_{10}H_{13}$

Name	Phenyl cyclotetra-methyleneborine
Formula	$C_6H_5B(CH_2)_4$
Molecular Weight	144.02
Characteristics	liquid - colorless
Solubility	s. org., d. air
Vapor Pressure	$85\text{-}7^{11}$
Addenda	spont. infl.

K. Torssell - Acta Chem. Scand., 8, 1779-86 (1954) I

BH_3Br_3P

Name	Tribromo borine-phosphine
Formula	$BBr_3 \cdot PH_3$
Molecular Weight	284.59
Characteristics	amorphous - white
Addenda	spont. infl.

Chem. Revs., 42, 581-615 (1942)

BH_3Br_3As

Name	Tribromoborine - arsine
Formula	$BBr_3 \cdot AsH_3$
Molecular Weight	328.54
Characteristics	liquid
Solubility	d. H_2O
Melting Point	7
Boiling Point	40 d.
Addenda	spont. infl.

Chem. Revs., 42, 581-615 (1942)

$BH_6NCl_2Si_2$

Name	Disilylamino dichloroborine
Formula	$(SiH_3)_2NBCl_2$
Molecular Weight	157.93
Characteristics	solid
Melting Point	62 d.
Vapor Pressure	25^{22}
Addenda	spont. infl.

$B_2CH_{11}NSi$

Name	(Methyl sily)amino diborane
Formula	$B_2H_5N(CH_3)(SiH_3)$
Molecular Weight	86.81
Characteristics	liquid - colorless
Solubility	s. org.; d. H_2O, air
Melting Point	-39.0
Boiling Point	51
Vapor Pressure	log p = 8.58 - 1800/T;0^{82}
Heat of Vaporization	(60) 7716 cal/mole
Addenda	spont. infl.

Callery Chemical Co. PB - 124518 (1951)
F.G.A. Stone - Quart, Revs. (London) 9 174-201 (1955)
JACS, 72, 3103-5 (1950)

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$B_2C_6H_{18}$

Name	Triethyl diborane
Formula	$(C_2H_5)_3B_2H_3$
Molecular Weight	111.82
Characteristics	liquid - colorless
Solubility	s. org.
Vapor Pressure	0^4
Addenda	spont. infl.

J. Chem. Phys., 8, 188 (1940)

$B_2C_{18}H_{40}O_2$

Name	Tetrabutyl diborinyl-oxyethane
Formula	$(C_4H_9)_2BOCH_2CH_2OB(C_4H_9)_2$
Molecular Weight	310.14
Characteristics	liquid - colorless
Solubility	s. org.
Refractive Index	(27/D) 1.4343; (25/D) 1.4323
Specific Gravity	(25) 0.8266
Vapor Pressure	144^2; 168-9^{10}; 133-4^1
Addenda	spont. infl.

R. L. Letsinger, I. Skoog - JACS 76 4174-6 (1954)

B_2H_5Cl

Name	Monochlordiborane
Formula	H_3BBH_2Cl
Molecular Weight	62.14
Characteristics	gas - colorless
Solubility	s. org.; d. H_2O, air
Melting Point	-142
Boiling Point	0
Vapor Pressure	-78^{18}
Addenda	spont. infl.

Callery Chemical Co. PB - 124518 (1951)

$B_2H_{11}NSi_2$

Name	Disilylaminodiborane
Formula	$B_2H_5N(SiH_3)_2$
Molecular Weight	102.92
Characteristics	liquid - colorless
Solubility	s. org.; d. H_2O, air
Melting Point	-68.8
Boiling Point	54 (60)
Vapor Pressure	$7.974-1669/T;0^{162}$
Heat of Vaporization	(54) 7640 cal/mole
Addenda	spont. infl.

Callery Chemical Co., PB - 124518 (1951)
F.G.A. Stone - Quart, Revs. (London) 9 174-201 (1955)

B_2Cl_4

Name	Tetrachloro diborine
Formula	B_2Cl_4
Molecular Weight	163.47
Characteristics	liquid - colorless
Solubility	d.H_2O
Melting Point	-91
Boiling Point	65.5
Addenda	spont. infl.

Callery Chemical Co., PB - 124518 (1951)
G. Urry, T. Wartik, R. E. Moore, H. I. Schlesinger - JACS, 76, 5293-8 (1954)

$B_3C_3H_9N_3Cl_3$

Name	N,N',N"-Trimethyl trichlorocyclo triborazine
Formula	$[CH_3NBCl]_3$
Molecular Weight	225.96
Characteristics	crystals
Solubility	s. org.; d. H_2O
Melting Point	156
Vapor Pressure	$120-30^{0.05}$subl.
Addenda	spont. infl.

H.S. Turner - Chem. & Ind. 1958 526

$B_3H_{12}Al$

Name	Aluminum tris (tetrahydroborane)
Formula	$Al(BH_4)_3$
Molecular Weight	71.54
Characteristics	liquid - colorless
Solubility	d. H_2O (exp.); s. org.
Specific Gravity	(0) 0.561; (10) 0.533; (20) 0.544; (29.4) 0.537
Melting Point	-64.5
Boiling Point	44.5
Vapor Pressure	$\log p = 7.808 - 1565/T$; 0^{120}; 17^{257}
Viscosity	$(23 \times 10^{-5})\ d^{1/3} e^{1291 d/T_p}$
Heat of Vaporization	7160 cal/mole
Heat of Combustion	13760 cal/gm
Addenda	spont. infl.
Surface Tension	$(61.0 - 0.130T) d^{2/3}$ dynes/cm

Callery Chemical Co., PB - 124518 (1951)

B_4H_{10}

Name	Tetraborane
Formula	B_4H_{10}
Molecular Weight	53.36
Characteristics	gas - colorless
Solubility	d. H_2O
Specific Gravity	(-35) 0.56
Melting Point	-120.0
Boiling Point	16-18
Heat of Vaporization	6.47 Kcal/mole
Addenda	spont. infl.

Callery Chemical Co., PB - 124518 (1951)

B_4Cl_4

Name	Boron chloride-tetramer
Formula	$(BCl)_4$
Molecular Weight	185.12
Characteristics	crystals - yellow
Melting Point	75 d.
Vapor Pressure	$23^{1.5}$; 68^{34}
Addenda	spont. infl.

G. Urry, T. Wartik, R.E. Moore, H.I. Schlesinger - JACS, 76, 5293-8 (1954)

B_5H_{11}

Name	Dihydropentaborane
Formula	B_5H_{11}
Molecular Weight	65.19
Characteristics	liquid - colorless
Solubility	d. alc., air
Melting Point	-123.1
Boiling Point	65 d.
Vapor Pressure	$0^{52.8}$; $-33.4^{7.2}$
Heat of Vaporization	7.61 Kcal/mole
Addenda	unstable; spont. infl.

Callery Chemical Co., PB - 124518 (1951)

B_6H_{10}

Name	Hexaborane
Formula	B_6H_{10}
Molecular Weight	75.00
Characteristics	liquid - colorless
Solubility	d. H_2O, alc.
Specific Gravity	0.69
Melting Point	-65
Boiling Point	110
Vapor Pressure	0^7
Addenda	spont. infl.

Callery Chemical Co., PB - 124518 (1951)

B_6H_{12}

Name	Dihydrohexaborane
Formula	B_6H_{12}
Molecular Weight	77.02
Characteristics	liquid - colorless
Solubility	d. alc.; s. org.
Melting Point	-90
Boiling Point	20 d.
Addenda	unstable; spont. infl.

Callery Chemical Co., PB - 124518 (1951)

ALUMINUM

$AlC_2H_5Cl_2$

Name	Ethyl dichloroalumine
Formula	$C_2H_5AlCl_2$
Molecular Weight	126.96
Characteristics	liquid - yellow
Solubility	d. H_2O, air
Specific Gravity	(25) 1.232
Melting Point	22
Boiling Point	194 (EXT)
Vapor Pressure	80^{12}; 100^{30}; 120^{69}; 160^{280}; 180^{515}
Viscosity	(23.3) 3.18 cp
Addenda	spont. infl.

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)

AlC_3H_9

Name	Trimethyl alumine
Formula	$(CH_3)_3Al$
Molecular Weight	72.09
Characteristics	liquid - colorless
Solubility	s. org.; d. H_2O, air
Refractive Index	(12/D) 1.432
Specific Gravity	(20) 0.752
Melting Point	15.4
Boiling Point	126
Vapor Pressure	$20^{8.4}$; $60^{68.5}$; 100^{332}
Heat of Combustion	10,500 cal/gm
Addenda	spont. infl.
Specific Heat	(33) 0.53

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)
K. Ziegler, H.G. Gellert, H. Martin, K. Nagel, J. Schneider - Ann., 589, 91-121 (1954)

$AlC_4H_{10}Cl$

Name	Diethyl chloroalumine
Formula	$(C_2H_5)_2AlCl$
Molecular Weight	120.56
Characteristics	liquid-colorless
Solubility	d. H_2O, air
Specific Gravity	(25) 0.958
Melting Point	-74
Boiling Point	208 ext.
Vapor Pressure	41^{1}; 90^{12}; 130^{65}; 170^{256}; 190^{465}
Viscosity	(23.3) 1.453 cp
Addenda	spont. infl.

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)
G. Pajaro - Ann.Chim. (Rome), 48, 193-7 (1958)

$AlC_5H_{15}O$

Name	Trimethyl alumine-dimethyl ether
Formula	$(CH_3)_3Al.(CH_3)_2O$
Molecular Weight	118.11
Characteristics	liquid
Solubility	s.org., d.H_2O
Melting Point	-30
Boiling Point	159
Addenda	spont. infl.

AlC_6H_{15}

Name	Triethyl alumine
Formula	$(C_2H_5)_3Al$
Molecular Weight	114.17
Characteristics	liquid-colorless
Solubility	s.org., d. H_2O, air
Refractive Index	(6.5/D) 1.480
Specific Gravity	(25) 0.8324
Melting Point	-46 (-52.5)
Boiling Point	194d.;207 ext.
Vapor Pressure	$48\text{-}50^{.004}$; $60^{0.8}$; 10^{13}; 140^{110}
Viscosity	(25) 2.58 cp
Addenda	spont. infl.
Specific Heat	(33) 0.527

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)
G. Pajaro - Ann.Chim. (Rome), 48, 193-7 (1958)

$AlC_7H_{19}O$

Name	Trimethyl alumine-diethyl ether
Formula	$(CH_3)_3Al.O(C_2H_5)_2$
Molecular Weight	146.21
Characteristics	liquid
Solubility	s.org., d.H_2O
Vapor Pressure	68^{15}
Addenda	spont. infl.

K. Ziegler, H.G. Gellert, H. Martin, K. Nagel, J. Schneider - Ann., 589, 91-121 (1954)

$AlC_{10}H_{23}O$

Name	Diethyl 4-ethoxy butylalumine
Formula	$(C_2H_5)_2Al(CH_2)_4OC_2H_5$
Molecular Weight	186.27
Characteristics	liquid - colorless
Solubility	d. air; s. org.
Vapor Pressure	$99.5^{5.5}$
Addenda	spont. infl.

G. Bahr, G. E. Muller - Chem.Ber., 88, 251-64 (1955)

$AlC_{10}H_{25}O$

Name	Triethyl alumine-diethyl ether
Formula	$Al(C_2H_5)_3(C_2H_5)_2O$
Molecular Weight	188.29
Characteristics	liquid - colorless
Refractive Index	(17.4/D) 1.4370; (17/Hα) 1.4343
Specific Gravity	(17/4) 0.8200
Boiling Point	216-8
Vapor Pressure	112^{16}
Addenda	spont. infl.

$AlC_{11}H_{26}N$

Name	Diethyl diethyl-amino-3-propyl alumine
Formula	$(C_2H_5)_2Al(CH_2)_3N(C_2H_5)_2$
Molecular Weight	199.32
Characteristics	liquid - straw
Solubility	d. air; s. org.
Melting Point	-2
Vapor Pressure	97^{2}
Addenda	spont. infl.

G. Bahr, G. E. Muller - Chem.Ber., 88, 251-64 (1955)

$Al_2C_3H_9Br_3$

Name	1,1,1-Trimethyl tribromo dialumene
Formula	$(CH_3)_3AlAlBr_3$
Molecular Weight	338.81
Characteristics	liquid - yellow
Solubility	s. org.; d. H_2O
Specific Gravity	(25) 1.514
Melting Point	4
Boiling Point	166ext.
Vapor Pressure	60^{15}; 80^{39}; 100^{89}; 120^{185}; 140^{359}; 160^{650}
Viscosity	(23.3) 2.76 cp
Addenda	spont. infl.

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)

$Al_2C_3H_{12}$

Name	1,1,2-Trimethyl dialumene
Formula	$(CH_3)_2HAlAlH_2(CH_3)$
Molecular Weight	102.09
Solubility	d.air,H_2O
Addenda	spont. infl.

N. Sidgewick, "Chemical Elements and Their Compounds", vol.I and II - Oxford, London (1950)

$Al_2C_4H_{10}I_4$

Name	1,2-Diethyl tetraiodo-dialumene
Formula	$C_2H_5I_2AlAlI_2C_2H_5$
Molecular Weight	619.72
Characteristics	liquid
Solubility	d.H_2O
Vapor Pressure	$158\text{-}60^4$
Addenda	spont. infl.

K. Ziegler, H. G. Gellert, H. Martin, K. Nagel, J. Schneider - Ann., 589, 91-121 (1954)

$Al_2C_4H_{14}$

Name	1,1,2,2-Tetra-methyldialumene
Formula	$(CH_3)_2HAlAlH(CH_3)_2$
Molecular Weight	116.12
Characteristics	liquid-colorless
Solubility	s.org.; d.H_2O
Boiling Point	d. 160
Addenda	spont. infl.

N. Sidgewick, "Chemical Elements and Their Compounds", vol.I and II - Oxford, London (1950)

$Al_2C_5H_{16}$

Name	Pentamethyl dialumene
Formula	$(CH_3)_3AlAlH(CH_3)$
Molecular Weight	130.14
Characteristics	liquid
Solubility	d.air
Addenda	spont. infl.

N. Sidgewick, "Chemical Elements and Their Compounds", vol. I and II - Oxford, London (1950)

$Al_2C_6H_{15}Cl_3$

Name	1,1,1-Triethyl trichlorodialumer
Formula	$(C_2H_5)_3AlAlCl_3$
Molecular Weight	247.52
Characteristics	liquid-yellow
Solubility	s.org.; d.H_2O
Specific Gravity	(25) 1.092
Melting Point	-20
Boiling Point	204 ext.
Vapor Pressure	90^{14}; 110^{34}; 130^{76} 170^{76}; 190^{525}
Viscosity	(23.3) 1.91 cp
Addenda	spont. infl.

Ethyl Corp. Bulletins - Aluminum Alkyls (Dec., 1958)

Al_xH_{3x}

Name	Aluminum hydride
Formula	$(AlH_3)_x$
Characteristics	solid - grey white
Solubility	d. H_2O, alc., air; s. eth.
Melting Point	100 d.
Addenda	spont. infl.

N. Sidgewick, "Chemical Elements and Their Compounds", vol.I and II - Oxford, London (1950)

GALLIUM

GaC_3H_9

Name	Trimethyl galline
Formula	$GA(CH_3)_3$
Molecular Weight	114.82
Characteristics	liquid - colorless
Solubility	d. H_2O; s. eth., NH_3
Melting Point	-15.8
Boiling Point	55.7
Vapor Pressure	$0^{64.5}$
Addenda	spont.infl.

G. E. Coates, R. G. Hayter - J.Chem.Soc., 1953, 2519
Handbook of Chemistry and Physics - Chemical Rubber Publishing Co., Cleveland (1958)

$Ga_2C_4H_{12}$

Name	Tetramethyl digalline
Formula	$(CH_3)_2GaGa(CH_3)_2$
Molecular Weight	199.58
Characteristics	liquid - colorless
Solubility	d. H_2O, air
Boiling Point	172 ext.
Vapor Pressure	$0^{0.5}$; 130^{500} d.
Addenda	spont. infl.

Ga_2H_6

Name	Digallane
Formula	H_3GaGaH_3
Molecular Weight	145.49
Characteristics	liquid - colorless
Solubility	d. H_2O, a., alk.
Melting Point	-21.4
Boiling Point	139 ext.
Vapor Pressure	$0^{2.5}$; 130^{700} d.
Addenda	spont. infl.

D. Hurd, Chemistry of the Hydrides - Wiley, New York (1952)

INDIUM

InC_3H_9

Name	Trimethyl indine
Formula	$In(CH_3)_3$
Molecular Weight	159.93
Characteristics	crystalline
Solubility	s.pol.org.; d. H_2O, air
Specific Gravity	(10) 1.568
Melting Point	88.4
Boiling Point	135.8
Vapor Pressure	$30^{7.2}$; 70^{72}
Addenda	spont.infl.

E. Wiberg, M. Schmidt, A.G. Galinos - Angew. Chem., 66, 444 (1954)
F. Runge, et al - Z.Anorg.u.allgem.Chem., 267, 39 (1951)
L. M. Dennis, et al - JACS, 56, 1047 (1934)

InC_6H_{15}

Name	Triethyl indine
Formula	$(C_2H_5)_3In$
Molecular Weight	202.40
Characteristics	liquid - colorless
Solubility	d. H_2O, air; s. org.
Specific Gravity	(20) 1.538
Melting Point	-32
Boiling Point	144
Addenda	spont.infl.

F. Runge, et al - Z.Anorg.u.allgem.Chem., 267, 39 (1951)

InC_9H_{21}

Name	Tripropyl indine
Formula	$(C_3H_7)_3In$
Molecular Weight	244.10
Characteristics	liquid - colorless
Solubility	s. org.; d. H_2O, air
Specific Gravity	(20) 1.501
Melting Point	-51
Boiling Point	178
Addenda	spont.infl.

F. Runge, et al - Z.Anorg.u.allgem.Chem., 267, 39 (1951)

THALLIUM

TlC_3H_9

Name	**Trimethyl thallane**
Formula	$(CH_3)_3Tl$
Molecular Weight	249.38
Characteristics	needles - colorless
Solubility	d. light, H_2O; s. org.
Melting Point	38.5
Boiling Point	147 ext.
Vapor Pressure	20^5; 90 exp.
Addenda	spont.infl.

H. Gilman, R. G. Jones - JACS, 61, 1513 (1939)
H. Gilman - JACS, 72, 1760 (1950)
H. P. Groll - JACS, 52, 2998 (1930)

ZIRCONIUM

$ZrBr_2$

Name	Dibromo zircine
Formula	$ZrBr_2$
Molecular Weight	251.05
Characteristics	powder-black
Solubility	d.H_2O
Melting Point	d. 350
Addenda	spont.infl.

SILICON

SiC_4H_{12}

Name	Tetramethyl silane
Formula	$(CH_3)_4Si$
Molecular Weight	88.23
Characteristics	liquid-colorless
Solubility	s.org.; i.H_2O
Refractive Index	(20/D) 1.3582
Specific Gravity	(26.2) 0.6361; (0/4) 0.6688; (17/4) 0.6497; (18.7) 0.6480; (20/4) 0.6480
Melting Point	(α) - 101.7; (β) - 99.5
Boiling Point	26.2
Heat of Vaporization	(26.2) 6.25 Kcal/mole
Heat of Formation	(l) -69 Kcal/mole; (g) -63 Kcal/mole
Heat of Combustion	-920 Kcal/mole
Addenda	spont.infl.

W. Merten, W. Kleeburg - German Patent 936,138 (1955)
S. Tannenbaum, S. Kaye, G. F. Lewenz - JACS, 75, 3753-7 (1953)
Silicones and Other Organic Silicon Compounds - M. Post - Reinhold Publ. Corp., New York (1949)

SiH_4

Name	Silane
Formula	SiH_4
Molecular Weight	32.12
Characteristics	gas - colorless
Solubility	d.air; alk.; s.org.
Specific Gravity	(-185) 0.68
Melting Point	-185
Boiling Point	-111.8
Heat of Formation	11.9 Kcal/mole
Addenda	spont.infl.

Hydrides of Boron and Silicon - A. Stock - Cornell Univ. Press (1933)

Si_2H_6

Name	Disilane
Formula	H_3SiSiH_3
Molecular Weight	62.23
Characteristics	gas - colorless
Solubility	s.org.;d. air; alk.
Specific Gravity	(-25) 0.686
Melting Point	-132.5
Boiling Point	-15
Addenda	spont.infl.

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio

Hydrides of Boron and Silicon - A.Stock - Cornell Univ. Press (1933)

$Si_2H_{11}NB_2$

Name	Disilylamino diborane
Formula	$B_2H_5N(SiH_3)_2$
Molecular Weight	102.92
Characteristics	liquid - straw
Solubility	s.org.; d.H_2O
Melting Point	-68.8
Boiling Point	54
Addenda	spont.infl.

$Si_3C_8H_{24}O_3N_2$

Name	Bis(ethylamino) siloxene
Formula	$[(C_2H_5)_2N]_2SiOSiH_2OSiH_2O$
Molecular Weight	280.57
Characteristics	solid - orange
Solubility	d. H_2O, air
Addenda	spont.infl.

H. Kautsky, H. P. Siebel - Z. anorg. u. allgem. chem., 273, 113-23 (1954)

Si_3H_8

Name	Trisilane
Formula	$H_3SiSiH_2SiH_3$
Molecular Weight	92.33
Characteristics	liquid - colorless
Solubility	s.org.; d. H_2O; air; CCl_4
Specific Gravity	(0) 0.743; (25) 0.725
Melting Point	-117.4
Boiling Point	53
Addenda	spont. infl.

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio
Hydrides of Boron and Silicon - A. Stock - Cornell Univ. Press (1933)

Si_3H_9N

Name	Trisilylamine
Formula	$(SiH_3)_3N$
Molecular Weight	107.35
Characteristics	liquid - colorless
Solubility	s. org.
Specific Gravity	(-106) 0.895
Melting Point	-105.6
Boiling Point	52
Addenda	spont.infl.

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio
Hydrides of Boron and Silicon - A. Stock - Cornell Univ. Press (1933)

Si_3H_9P

Name	Trisilylphosphine
Formula	$(SiH_3)_3P$
Molecular Weight	124.32
Characteristics	liquid - colorless
Solubility	s.org.; d. H_2O; air
Vapor Pressure	0^{83}
Addenda	spont.infl.

B. J. Aylett, H. J. Emeleus, B. G. Maddoch - J. Inorg. & Nucl. Chem., 1, 187-93 (1955)

Si_4H_{10}

Name	Tetrasilane
Formula	$H_3SiSiH_2SiH_2SiH_3$
Molecular Weight	122.44
Characteristics	liquid - colorless
Solubility	s. org.; d. H_2O; air
Specific Gravity	(0) 0.79
Melting Point	-93.5
Boiling Point	109
Addenda	spont.infl.

Handbook of Chemistry & Physics, 36th ed., 1954, Chemical Rubber Publ. Co., Cleveland, Ohio
Hydrides of Boron and Silicon - A.Stock - Cornell Univ. Press (1933)

Si_xH_{2x}

Name	Silicon hydride
Formula	$(SiH_2)_x$
Characteristics	solid - brown
Solubility	d. a., alk.
Melting Point	d. $25^{0.01}$
Addenda	spont.infl.

PHOSPHORUS

PCH_2F_3

Name	Trifluormethyl phosphine
Formula	CF_3PH_2
Molecular Weight	102.00
Characteristics	gas - spon infl.
Boiling Point	-25.5

F. W. Bennett, H. J. Emeleus, R. N. Haszeldine - J. Chem. Soc., 1954 3896-3904

PC_2HF_6

Name	Bis(trifluormethyl) phosphine
Formula	$(CF_3)_2PH$
Molecular Weight	170.01
Characteristics	gas - colorless - spon. infl.
Solubility	s. pol. org.
Boiling Point	1

F. W. Bennett, H. J. Emeleus, R. N. Haszeldine - J. Chem. Soc., 1954 3896-3904

PC_2H_7

Name	Dimethyl phosphine
Formula	$(CH_3)_2PH$
Molecular Weight	62.05
Characteristics	liquid - colorless - spont. infl.
Solubility	s. org., d. air
Boiling Point	25
Vapor Pressure	-47^{30}

PC_3F_9

Name	Tris(trifluormethyl) phosphine
Formula	$(CF_3)_3P$
Molecular Weight	238.01
Characteristics	liquid - colorless - spont. infl.
Solubility	d. H_2O, s. pol. org.
Boiling Point	17.3
Heat of Vaporizaticn	5890 cal/mole

F. W. Bennett, H. J. Emeleus, R. N. Haszeldine - J. Chem. Soc., 1953, 1565-71

PH_3

Name	Phosphine
Formula	PH_3
Molecular Weight	34.00
Characteristics	gas - colorless - poisonous - spon. infl.
Solubility	sl. s. H_2O, s. al., et
Specific Gravity	1.317 (l); (0) 1.529g
Melting Point	-133.5
Boiling Point	-87.4
Heat of Formation	2.3 Kcal/mole
Entropy	(25) (g) 50.23 cal/deg mole

E. L. Gefter - Z. Obschel Kh., 28, 1338-40 (1958)
A. P. Altshuller – JACS, 77, 4220-1 (1955)

PH_9Si_3

Name	Trisilyl phosphine
Formula	$P(SiH_3)_3$
Molecular Weight	124.32
Characteristics	liquid - colorless - spon. infl.
Solubility	d. H_2O
Vapor Pressure	0^{83}

B. J. Aylett, H. J. Emeleus, A. G. Maddock - J. Inorg. & Nucl. Chem., 1, 187-93 (1955)

PSF_3

Name	Trifluoro phosphane sulfide
Formula	$(S)PF_3$
Molecular Weight	120.04
Characteristics	gas - spon. infl.
Solubility	d. H_2O, s. eth., i. org.
Melting Point	-148.8
Boiling Point	d. -52.3

Booth, et al - JACS, 61, 2927, 2934, 2937, 3120 (1939)
Jackson and Davis - J. Chem. Soc., 1931, 2109-15

ARSENIC

AsC_2H_6Cl

Name	Dimethyl chloro-arsine
Formula	$(CH_3)_2AsCl$
Molecular Weight	140.44
Characteristics	liquid - colorless; spon. infl.
Solubility	i. H_2O; eth. s. alc. org.
Specific Gravity	(25) > 1
Melting Point	< -45
Boiling Point	106.5

AsC_2H_7

Name	Dimethyl arsine
Formula	$(CH_3)_2AsH$
Molecular Weight	105.99
Characteristics	liquid - colorless; spon. infl.
Solubility	s. org.
Specific Gravity	(20) 1.213; (25) 1.210
Boiling Point	35.6-7.0

D. Seyferth, E. G. Rochow - J. Org. Chem., 20, 250-6 (1955)

AsC_4H_{11}

Name	Diethyl arsine
Formula	$(C_2H_5)_2AsH$
Molecular Weight	134.04
Characteristics	liquid - colorless; spont. inflam.
Solubility	s. org.
Refractive Index	(25/D) 1.4709
Specific Gravity	(23/4) 1.338
Boiling Point	105 (96.5-97)

"Handbook of Chemistry and Physics" - Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

AsH_9Si_3

Name	Trisilyl arsine
Formula	$As(SiH_3)_3$
Molecular Weight	168.25
Characteristics	liquid; spont. infl.
Solubility	d. H_2O
Boiling Point	d. 25
Vapor Pressure	$0^{1.7}$

B. J. Aylett, et al - J. Inorg. & Nucl. Chem., 1, 187-93 (1955)

$As_2C_8H_{20}$

Name	Tetraethyl diarsine
Formula	$(C_2H_5)_2AsAs(C_2H_5)_2$
Molecular Weight	266.07
Characteristics	liquid; spont. inflam.
Solubility	i. H_2O; s. alc. eth.
Refractive Index	(25/D) 1.4709
Specific Gravity	(23.7/4) 1.2
Boiling Point	185-90

"Handbook of Chemistry and Physics" - Chemical Rubber Publishing Co., Cleveland, Ohio (1958)

TUNGSTEN

$WC_{48}H_{60}O_3Li$

Name	Triphenyl tungsten-tris(phenyl lithium) tris (diethyl ether)
Formula	$(C_6H_5)_3W \cdot 3LiC_6H_5 \cdot 3(C_2H_5)_2O$
Molecular Weight	875.81
Characteristics	violet
Solubility	s. org.; d. H_2O; alc.
Addenda	spon. infl.

MANGANESE

$MnC_{10}H_{10}$

Name	Dicyclopentadienyl manganese
Formula	$(C_5H_5)_2Mn$
Molecular Weight	185.13
Characteristics	crystalline - amber; paramagnetic; spon. infl.
Solubility	d. a. H_2O; air, s. NH_3; THF, pyr. i. aliph.
Melting Point	172-3
Boiling Point	245
Vapor Pressure	$100\text{-}30^{10^{-4}}$ -10^{-5}
Heat of Vaporization	12.0 Kcal/mole
Dipole Moment	5.8
Heat of Sublimation	17.3 Kcal/mole
Specific Conductivity	(-33) 1.4×10^{-5} (NH_3)
Heat of Fusion	6.3 Kcal/mole

G. Wilkenson, F. A. Cotton, J. M. Birmingham - J. Inorg. & Nucl. Chem., 2, 95-113 (1956)

PART II

ALUMINUM BOROHYDRIDE $Al(BH_4)_3$

Ref. 1 - P. 164

- is an unstable covalent liquid. The compound melts at -64.5° and has a vapor pressure of 119.5 mm Hg at 0°. Its boiling point is estimated to be 44.5°. It will ignite in air if trace of moisture is present. Its reaction with water is explosively violent.

It forms additional compounds with amines readily.

BARIUM HYDRIDE BaH_2

Ref. 1 - P. 47-48

A white crystalline solid, density 4.21 gm/cm^3,

ΔH_f = 40.96 Kcal/mole.

Orthorhombic with unit cell dimensions of a = 6.788 A.U.

b = 7.829 A.U.

c = 4.167 A.U.

Barium hydride is insoluble in common solvents, except those with which it reacts.

If the hydride is finely powdered, it may ignite spontaneously if it is exposed to moist air.

BERYLLIUM BOROHYDRIDE $Be(BH_4)_2$

Ref. 1 - P. 163

- is a solid material with considerable covalent character. The vapor pressure of $Be(BH_4)_2$ at 0° is ca. 0.5 mm Hg; normal sublimation temperature is 91.3°. The compound is soluble in organic solvents including non-polar solvents like benzene. It is spontaneously inflammable in air and reacts very vigorously with water and other reducing agents. It begins to decompose at 123°.

BERYLLIUM HYDRIDE BeH_2

Ref. 1

A non-volatile white solid, insoluble in ether, toluene and isopentane. Decomposes rapidly at 125°. Its reaction with water, even at -196°, is quite violent.

CALCIUM HYDRIDE CaH_2

Ref. 1

A white, crystalline solid, melts above 1000°, density of 1.9 gm/cm^3, ΔH_f = 46.6 Kcal/mole. Insoluble in all the conventional inorganic and organic solvents. Not violently reactive with water.

CALCIUM PHOSPHIDE Ca_3P_2

The action of water on Ca_3P_2 produces phosphine (PH_3) and diphosphine (P_2H_4). The diphosphine ignites spontaneously on contact with air.

$$\Delta H_f = \frac{-120.5 \text{ Kcal}}{\text{mole}}$$

DECABORANE $B_{10}H_{14}$

Ref. 1

White crystalline solid, stable, melts at 99.50, boils at 213°, density 0.94 gm/cm^3 at 25°, vapor pressure 19.0 mm @ 100°. At room temperature and in contact with water, a sample of decaborane will be less than 10% hydrolyzed in 10 days; hydrolysis at 100° is even very slow.

DIBORANE B_2H_6

Ref. 1

A colorless gas, relatively stable, melts at -165.5°, boils at -92.5°, density = 0.44 gm/cm^3 and ΔH_f = -6.7 Kcal/mole.

In presence of water vapor, will ignite spontaneously in air.

DIETHYL ZINC

Ref. 3

Melts at -30 and boils at 117.6°. Ignites spontaneously on contact with air.

DIPHOSPHINE PH_2 or P_2H_4

Ref. 1

The only Group V hydride known to be spontaneously inflammable. It is a liquid whose melting point is -99° and boiling point is 51.7°.

LITHIUM HYDRIDE

Ref. 1

M_1P_1 ca. 680°

Density ca. 0.78

ΔH_f = 22 Kcal/mole (21.61)

In the massive form LiH_2 reacts fairly briskly, but without ignition, upon being dropped into a large excess of water.

However, the addition of a small amount of water to a sizeable amount of finely divided LiH_2 results in the generation of sufficient heat to ignite the mass of hydride, and a violently exothermic reaction occurs.

MAGNESIUM HYDRIDE

Ref. 2

In the air, magnesium hydride is oxidized to magnesium oxide and water with "self-inflammation".

Ref. 1

A white, non-volatile polymeric solid. It does not ignite spontaneously on exposure to air. Does not begin to decompose until a temperature of 280° is reached. It does react vigorously with water.

MAGNESIUM PHOSPHIDE Mg_3P_2

The action of water on Mg_3P_2 produces phosphine (PH_3) and diphosphine (P_2H_2). The diphosphine is spontaneously ignited on contact with air.

METHYLPHOSPHINE CH_3PH_2

Ref. 1

Boils at 25° and it is spontaneously inflammable.

PHOSPHOROUS, WHITE

SODIUM HYDRIDE NaH

A gray-white crystalline powder, density 1.396 gm/cm^3 (commercial about 0.95 gm/cm^3), ΔH_f = 13.8 Kcal/mole.

If this material is finely powdered, a spontaneous ignition may occur in moist air.

NaH and water is a very violent reaction, more so than pure sodium and water.

STRONTIUM HYDRIDE SrH_2

A white crystalline solid, density 3.77 gm/cm^3, ΔH_f = 42.2 Kcal/mole.

It is insoluble in normal solvents, but is vigorously reactive with water.

TETRABORANE B_4H_{10}

Ref. 1

Colorless gas, unstable, melts at -120°, boils at 16°, density 0.56 gm/cm^3 at -35°.

TETRASILANE Si_4H_{10}

A colorless, spontaneously inflammable volatile liquid with a melting point of -93.5° and boiling point of 109°.

TRIETHYL ALUMINUM Et_6Al_2

Ref. 3

Melts at -52.5°, boils at 185.6°. Ignites spontaneously.

TRIETHYL INDIUM Et_3In

Ref. 3

Melts at -32°, boils at 144° and does not appear to form an ether complex.

Spontaneously inflames in the air.

TRIMETHYL ALUMINUM Me_6Al_2

Ref. 3

Melts at 15.0°, boils at 126° and is a clear mobile liquid at room temperature.

Explosively hydrolyzed by water and ignites spontaneously in air.

TRIMETHYL ALUMINUM-DIMETHYL ETHER COMPLEX

Ref. 3

Melts at -29.9°, boils at 159°, and spontaneously inflammable.

TRIMETHYL INDIUM Me_3In

Ref. 3

Melts at 88.4°, boils at 135.8°. Has a vapor pressure of 7.2 mm at 30°.

Spontaneously inflames in air.

TRIMETHYL THALLIUM Me_3Tl

Melts at 38.5°, boils about 147°, and is spontaneously inflammable.

TRI-N-PROPYL INDIUM $(n\text{-}C_3H_2)_3In$

Melts at -51°, boils at 178°, is monomeric in benzene. Spontaneously inflames in air.

ZINC PHOSPHIDE Zn_3P_2

The action of water on Zn_3P_2 produces phosphine (PH_3) and diphosphine (PH_2). The diphosphine ignites spontaneously at contact with air.

ALUMINUM PHOSPHIDE

RDTR No. 71

DIETHYL ALUMINIUM CHLORIDE

WATER REACTIVE CHEMICALS

Alkali Metals

Metallic Hydrides

Metallic Phosphides

Metallic Peroxide - Fuel Mixtures

AIR REACTIVE CHEMICALS

Organo-metallic Compounds

Pyrophoric Metals and Alloys

White Phosphorous

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3. Coates, G. E., "Organo-Metallic Compounds", 1956, John Wiley & Sons, Inc., N. Y.

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13. ABSTRACT

Properties of air reactive compounds are listed.

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Security Classification

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It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS), (S), (C), or (U)*.

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14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, roles, and weights is optional.